

REMARKS

This amendment is filed in response to the Office Action dated October 25, 2001, in which claims 2-5, 7-21, 29, 32-37, 39, and 42-44 have been rejected under 35 USC §112, second paragraph; and in which claims 1-3, 8-12, 17-21, 26-38, and 40-44 have been rejected under 35 USC §102(b); and in which claims 6, 7, 15, 16, 22-25, and 39 have been rejected under 35 USC §103(a).

A new drawing labeled as FIGURE 6 has been added to show the “arcuately-formed flank surface [which] is convex relative to said tooth.” A new sentence has been added to the Brief Description of the Drawings to describe FIGURE 6. Also, a paragraph describing FIGURE 6 has been added as the penultimate paragraph of the Detailed Description. Basis for the new FIGURE 6 is found in the originally filed claims.

Claim 42 has been cancelled without prejudice. Claims 1, 3-10, 12-19, 21-25, 27, 28, 29, 30, 31, 33-36, and 38 remain from the original claims from the application as filed. Claims 2, 11, 20, 26, 32, 37, 39-41, 43, and 44 have been amended to address the Examiner’s rejections. Claims 45 and 46 have been newly added. No new matter has been added. Applicants thank the Examiner for amending the IDS as submitted to comply with 37 CFR §§1.97 and 1.98 and MPEP §609.

Claims 2, 11, 20, 32, 37, and 39 have been amended to address the 35 USC §112, second paragraph, rejections put forth by the Examiner.

The Examiner has rejected claims 7 and 16 stating that the limitation “about 0.5 degrees to about 2.0 degrees” is unclear because of the relative term “about.” The descriptive term “about” is not indefinite, and it is clear and flexible. *Ex parte Eastwood*, 163, USPQ 316 (Bd. App. 1968). Applicants recite the limitation as being bounded on its lower end by “about 0.5 degrees” and as being bounded on its upper end by “about 2.0 degrees.” Courts have deemed the term “about” to be indefinite when preceded by terms such as “at least” and when there is nothing in the specification, prosecution history, or prior art to provide any indication as to what range is covered by the term “about.” Applicants point out that the limitation as recited in claims 7 and 16 does not include the term “at least” (or any similar or equivalent term) and that it is bounded at both ends. As such, Applicants believe that claims 7 and 16 are allowable, and respectfully request that

the rejection thereof be withdrawn. Furthermore, because the limitation was recited in the claim as originally filed, Applicants' have moved it to the detailed description of the specification at the last paragraph on page 7.

Claims 1-3, 8-12, 17-21, 38, and 40-44 have been rejected under 35 USC §102(b) as being anticipated by Visser (United States Patent No. 3,122,938). The Examiner's rejections of claims 1-3, 8-12, 17-21, 38, 40, 41, and 44 are traversed, and reconsideration is respectfully requested for the following reasons.

Applicants respectfully submit that claim 1 is not anticipated under 35 USC §102(b) because aspects of Applicants' claim 1 are not taught by Visser either explicitly or implicitly. For an invention to be anticipated under 35 USC §102, the reference must teach each and every aspect of the claimed invention either expressly or impliedly. Visser teaches a gear having a web 14 disposed on a hub 12, a rim 10 disposed on web 14, and rigid teeth 16 disposed on rim 10. "Web 14 is a flexible diaphragm of relatively thin material which is adapted to be flexed to cause the gear teeth 16 to mesh with a helical gear." (Column 2, lines 22-25). The teeth of the Visser invention are *rigid* (column 2, lines 15, 30, and 52-53) (emphasis added). Furthermore, "[w]hen it is stated...that the web...is flexible while the hub, rim and teeth are rigid,...what is meant is that [the deformation of] the hub, rim, and teeth ...is insignificant compared to the deformation of the web." (Column 2, lines 29-33). Moreover, "it is *essential* that the deformation of rim 10, teeth 16 and hub 12 be insignificant compared to the deformation of web 14." (Column 2, lines 41-43) (emphasis added).

Visser fails to teach a worm gear having a plurality of teeth flexibly disposed on the gear, as is taught in Applicants' claim 1. Visser is silent as to the teaching of flexibly disposed teeth as part of his gear combination. In fact, the teeth of the Visser invention are necessarily not flexibly disposable on the gear because they are rigid and insignificantly deformable and they are disposed on a rigid and insignificantly deformable rim. As such, Applicants maintain that a worm gear having teeth flexibly disposed thereon is patently distinct from a gear having rigid and insignificantly deformable teeth disposed on a rigid and insignificantly deformable rim. Consequently, because Visser does not teach what Applicants claim (a worm gear having teeth flexibly disposed thereon), Visser does not teach each and every aspect of Applicants' claim 1.

Therefore, because Visser does not teach each and every aspect of Applicants' invention as claimed in claim 1, Applicants' claim 1 is not anticipated by Visser. Claim 1 is therefore asserted to be allowable. Applicants, therefore, respectfully request that the rejection of claim 1 be withdrawn.

Applicants further assert that claims 2, 3, 8-12, and 17-21 depending from claim 1 are likewise allowable. A dependent claim is directed to a combination including everything recited in the base claim and what is recited in the dependent claim. (MPEP §608.01(n)). The addition of limitations by dependent claims to a novel independent claim combines the subject matter of the independent claim with the subject matters of each of the dependent claims to further define the subject matter of the independent claim. Applicants' claims 2, 3, 8-12, and 17-21 combine the subject matter of claim 1 with the subject matters of each of those dependant claim to further define claim 1. Applicants, therefore, assert that because claim 1 is novel and because claims 2, 3, 8-12, and 17-21 depend from claim 1 to further define claim 1, claims 2, 3, 8-12, and 17-21 are necessarily novel. Applicants, therefore, respectfully request that the rejection of claims 2, 3, 8-12, and 17-21 be withdrawn.

With respect to claim 38, Applicants submit that claim 38 is not anticipated under 35 USC §102(b) because aspects of Applicants' claim 38 are not taught by Visser either explicitly or implicitly. For an invention to be anticipated under 35 USC §102, the reference must teach each and every aspect of the claimed invention either expressly or impliedly. Visser teaches a gear meshing in which "the teeth of gear 102 are wedged by an interference fit into the worm 100." (Column 3, lines 61-63). The interference fit is effected by the spring loading of the elastic web. (Column 1, lines 40-41). Spring loading of the web causes it to "oilcan to keep the axis of shaft 110 normal to the axis of worm 100." (Column 3, lines 69-70).

Visser fails to teach a worm/worm gear assembly in which the contact area between a tooth of the worm and a tooth of the worm gear is smaller at a low load condition and larger at a high load condition. In particular, the rigidity of the teeth of the Visser invention precludes the variation of the size of the contact areas at varying load conditions because the teeth of the Visser invention do not flex. Therefore, Applicants assert that the worm/worm gear assembly of their claim 38 is patentably distinct from the

invention of Visser. Consequently, because Visser does not teach what Applicants claim, viz., a worm gear engaged in double flank contact with a worm wherein at a low load condition a contact area between a tooth of the worm and a tooth of the worm gear is smaller in size than the contact area is at a higher load condition, Applicants' claim 38 is not anticipated by Visser. Applicants' claim 38 is therefore believed to be allowable, and Applicants respectfully requests that the rejection of claim 38 be withdrawn.

With respect to claim 40, Applicants submit that claim 40 is not anticipated under 35 USC §102(b) because aspects of Applicants' claim 40 are not taught by Visser either explicitly or implicitly. For an invention to be anticipated under 35 USC §102, the reference must teach each and every aspect of the claimed invention either expressly or impliedly. Visser teaches "spring load[ing] an interference fit between the teeth of a helical gear and a worm or between the teeth of a spur gear and a worm." (Column 1, lines 52-54). Visser fails to teach the maintaining of double flank contact at opposing edges of facing successive worm gear teeth such that during low- or no-load conditions, double flank contact is maintained between teeth of the worm and the worm gear at outer edges of each of the facing successive worm gear teeth and during higher load conditions the double flank contact extends toward the center of each of the facing successive worm gear teeth, as is claimed in Applicants' amended claim 40. Because Visser does not teach what Applicants claim in their amended claim 40, Applicants' claim 40 is not anticipated by Visser. Amended claim 40 is therefore believed to be allowable. Applicants further assert that claims 41 and 44, which depend from claim 40, are likewise allowable. Applicants, therefore, respectfully request that the rejection of claims 40, 41, and 44 be withdrawn.

Claims 26-31 have been rejected under 35 USC §102(b) as being anticipated by Steiner (United States Patent No. 2,669,138). The Examiner's rejections of claims 26-31 are traversed, and reconsideration is respectfully requested for the following reasons.

Applicants respectfully submit that claim 26 is not anticipated under 35 USC §102(b) because aspects of Applicants' claim 26, as amended, are not taught by Steiner either explicitly or implicitly. For an invention to be anticipated under 35 USC §102, the reference must teach each and every aspect of the claimed invention either expressly or impliedly. Steiner teaches a gear having gear teeth 20 in which the teeth are arcuately-

formed in the plane of the pitch circle, i.e., the faces 30 of the teeth 20 “coincide with the circle 25d.” (Column 3, lines 5-8).

Steiner fails to teach a gear having teeth wherein each tooth is defined by two arcuately-formed flank surfaces, the “flank surfaces being arcuately formed across a width of each tooth...” In particular, Steiner refers to the faces of the teeth 20 of his gear coinciding with the shape of a circle. Because a circle is two-dimensional, transposing such a circle across the pitch circle of a gear tooth yields a uniform contour across the tooth width. Because the dimension across the tooth width is uniform, the dimension across the tooth width necessarily cannot be arcuate. Consequently, because Steiner does not teach what Applicants claim, viz., a gear tooth having two arcuately-formed flank surfaces wherein the flank surfaces are arcuately-formed across a width of the tooth, Steiner does not teach each and every aspect of Applicants’ claim 26. Therefore, because Steiner does not teach each and every aspect of Applicants’ invention, viz., gear teeth having arcuately-formed flank surfaces across the width of the teeth, Applicants’ claim 26 is not anticipated by Steiner. Amended claim 26 is therefore believed to be allowable. Applicants, therefore, respectfully request that the rejection of claim 26 be withdrawn.

Applicants further assert that claims 27, 28, 30, and 31 depending from claim 26 are likewise allowable. A dependent claim is directed to a combination including everything recited in the base claim and what is recited in the dependent claim. (MPEP §608.01(n)). The addition of limitations by dependent claims to a novel independent claim combines the subject matter of the independent claim with the subject matters of each of the dependent claims to further define the subject matter of the independent claim. Applicants’ claims 27, 28, 30, and 31 combine the subject matter of claim 26 with the subject matters of each of those dependant claims to further define claim 26. Applicants, therefore, assert that because claim 26 is novel and because claims 27, 28, 30, and 31 depend from claim 26 to further define claim 26, claims 27, 28, 30, and 31 are necessarily novel. Applicants, therefore, respectfully request that the rejection of claims 27, 28, 30, and 31 be withdrawn.

Claims 32-37 have been rejected under 35 USC §102(b) as being anticipated by Pickles (United States Patent No. 2,760,381). In accordance with the Examiner’s suggested approach to overcoming this rejection, Applicants have positively recited the

worm meshing with the worm gear in double flank contact. Amended claim 32 is now believed to be allowable. Furthermore, claims 33-37, which depend from claim 32, are also believed to be allowable. Applicant, therefore, respectfully requests that the rejection of claims 32-37 be withdrawn.

Claims 6, 7, 15, 16, 22-25, and 39 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Visser. The Examiner alleges that it would have been obvious to one of ordinary skill in the art to set the helix angle of the worm less than the helix angle of the worm gear by 0.5 to 2.0 degrees, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art.

Applicants respectfully submit that claims 6, 7, 15, and 16 are not obvious over Visser because Visser does not teach or suggest a worm gear having a plurality of teeth flexibly disposed thereon to facilitate the outboard mechanical double flank communication aspects of the worm/worm gear assembly of claim 1 from which claims 6, 7, 15, and 16 depend. A prima facie case of obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. As stated above, Visser teaches a gear having a web 14 disposed on a hub 12, a rim 10 disposed on web 14, and rigid teeth 16 disposed on rim 10. Web 14 is a flexible diaphragm of relatively thin material that is adapted to be flexed to allow the rigid gear teeth 16 to mesh with the teeth on another gear. Visser teaches that it is *essential* that the deformation of rim 10, teeth 16, and hub 12 be insignificant compared to the deformation of the web 14. (Emphasis added).

Visser fails to teach or suggest a worm gear having teeth *flexibly disposed thereon*, as is claimed by Applicants in their claim 1 from which claims 6, 7, 15, and 16 depend. The flexible web 14 of Visser does not teach or suggest flexible teeth, particularly because Visser teaches that it is “essential that the deformation of ...[the]...teeth 16 and be insignificant compared to the deformation of web 14.” (Column 2, lines 41-43). Applicant asserts that if it is *essential* that the deformation of the teeth be insignificant, then the teeth must be rigid. Because Visser does not teach or

suggest flexible teeth as is taught in claim 1 from which 6, 7, 15, and 16 depend, Visser does not teach or suggest Applicants' invention. Furthermore, because claim 6, 7, 15, and 16 depend from claim 1, (which Applicants assert to be non-obvious), and because claims that depend from a claim that is non-obvious are themselves non-obvious, claims 6, 7, 15, and 16 are necessarily non-obvious. Accordingly, Applicants claims 6, 7, 15, and 16 are necessarily not obvious over Visser, and Applicants respectfully request that the rejection thereof be withdrawn.

Claims 22 and 25 have been rejected under 35 USC §103(a) as being unpatentable over Visser. The Examiner alleges that Visser does not disclose the spring rate of the worm gear but that the flexible web portion inherently has a spring rate that increases as the load on the gear is increased.

Applicants' respectfully submit that claims 22-25 are not obvious over Visser because Visser does not teach double flank contact between two gears wherein a no-load or a low-load condition is carried at a low spring rate and a higher load condition is carried at a higher spring rate, as is claimed in Applicants' claim 22. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found with explicitly or implicitly in the references themselves or in the knowledge that is generally available to one of ordinary skill in the art. Visser teaches the meshing of the gear 56 with a gear 4 wherein it is necessary that the web 17 of gear 4 deforms such that the teeth of each gear are maintained in contact via a spring loading of flexible diaphragms. (Column 3, 44-47). The circumferential distance from end to end of one individual tooth of one gear is slightly greater in the tooth to tooth spacing in a meshing gear that accommodates the individual tooth of the first gear. (Column 3, lines 47-51). Thus, Visser defines an interference fit between the gear teeth. Visser fails to teach any variation in the interference fit, such interference fit being defined by double-flank contact between the gears wherein a no-load or a low-load condition is carried out at a low spring rate and a higher load condition is carried out at a higher spring rate, as is claimed in Applicants' claim 22. Because Visser does not teach or suggest such a variation in the double flank contact at varying spring rate conditions, Visser does not teach or suggest what Applicants claim. Furthermore, because claims 23-25 depend from

claim 22, (which Applicants assert to be non-obvious), and because claims that depend from a claim that is non-obvious are themselves non-obvious, claims 22-25 are necessarily non-obvious. Accordingly, Applicants' claims 22-25 are necessarily non-obvious over Visser, and Applicants respectfully request that the rejections thereof be withdrawn.

Claim 39 has been rejected under 35 USC §103(a) as being unpatentable over Visser. Applicants respectfully submit that claim 39 is not obvious over Visser because Visser does not teach a worm gear having flexible teeth, as is taught in Applicants' amended claim 39. To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. Visser teaches helical gear teeth disposed in an interference fit with the teeth of another gear. The helix angles of the gears are either directed in opposite directions to form the interference fit (column 3, lines 58-61) or, if the gears are a worm and a worm gear, the helix angles may not match (column 3, lines 66-67). In either case, the interference fit is effected by spring loading the rigid teeth of one gear with the rigid teeth of another gear. (Column 1, lines 44-47). Visser does not teach a worm and a helical cut worm gear *having flexible teeth* wherein a helix angle of the worm is less than a helix angle of the worm gear, as is taught in Applicants' amended claim 39. Because Visser does not teach or suggest a worm and a helical cut worm gear having flexible teeth wherein a helix angle of the worm is less than a helix angle of the worm gear, Visser does not teach or suggest all the claim limitations of Applicants' invention. Consequently, because Visser does not teach all of the claim limitations of Applicants' invention, Applicants' amended claim 39 is necessarily non-obvious, and Applicants respectfully request that the rejection thereof be withdrawn.

The Examiner has indicated that claims 4, 5, 13, and 14 would be allowable if rewritten to overcome the rejections written under 35 USC §112, second paragraph, and to include all of the limitations of the base claims and any intervening claims associated therewith. As stated above, Applicants have rewritten claims 4 and 5 to include all of the limitations of the base claim and the intervening claims and presented them as new claim 45. Applicants have also rewritten claims 13 and 14 to include all of the limitations of the base claim and the intervening claims and have re-presented them as new claim 46.

In view of the foregoing points that distinguish Applicants' invention from those of the prior art and render Applicants' invention not obvious, Applicants respectfully request that the Examiner reconsider the present application, remove the rejections, and allow the application to issue.

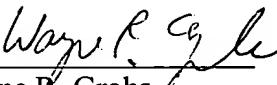
If the Examiner believes that a telephone conference with Applicants' attorneys would be advantageous to the disposition of this case, the Examiner is invited to telephone the undersigned.

If additional charges are incurred with respect to this Amendment, they may be charged to Deposit Account Number 06-1130 maintained by Applicants' attorneys.

Respectfully submitted,

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Marked up version to show changes made:

Marked up version of the last paragraph on page 7:

One manner of maintaining the double flank contact between teeth 24, 26 of worm/worm gear assembly 10 can be achieved through the alteration of helix angles α , β of worm 12 and worm gear 14. Such alteration of helix angles α , β allows for contact to be maintained on facing flanks of teeth 26 of worm gear 14 when no additional torsional load is imposed on worm/worm gear assembly 10. Alteration of helix angles α , β can be attained by changing the dimensions and positioning of teeth 24, 26, or it can be attained by skewing axes of rotation 16, 20 of either or both of worm 12 and worm gear 14. Helix angles α , β are generally altered such that the difference therebetween is about 0.5 degrees to about 2.0 degrees. The resulting double flank contact allows for a smooth power transmission between worm 12 and worm gear 14, a smooth transition between spring rates, and a minimum amount of turning torque.

Marked up version of claim 2:

CLAIM 2. (amended) The worm/worm gear assembly of claim 1 wherein each of said teeth of the worm includes a first flank surface and an opposing second flank surface, and wherein each of said teeth of said worm gear includes a first flank surface and an opposing second flank surface, said outboard mechanical double flank communication being maintained such that contact is made between said first flank surface of at least one of said teeth of said worm and said first flank surface of at least one of said teeth of said worm gear, and such that contact is made between said opposing second flank surface of said at least one of said teeth of said worm and a flank surface facing said first flank surface of said at least one tooth of said worm gear on a successive tooth of said worm gear.

Marked up version of claim 11:

CLAIM 11. (amended) The worm/worm gear assembly of claim 1 wherein at least one of said [gear] worm and said worm gear are fabricated from a resilient material.

Marked up version of claim 20:

CLAIM 20. (amended) The worm/worm gear assembly of claim 12 wherein at least one of said [gear] worm and said worm gear are fabricated from a resilient material.

Marked up version of claim 26:

CLAIM 26. (amended) A single part gear capable of reducing backlash, comprising: a plurality of teeth disposed on an outer edge thereof, each tooth of said plurality of teeth having two arcuately-formed flank surfaces [and] , said flank surfaces being arcuately-formed across a width of each tooth of said gear, and said gear being efficiently operable [when combined with a worm from no-load conditions through higher] under load conditions.

Marked up version of claim 32:

CLAIM 32. (amended) An operable worm gear efficient at no- or low-load conditions and at higher load conditions [configurable] such that double flank meshing contact is maintained between said operable worm gear and a worm to [engage in double flank contact with a worm to] eliminate backlash between said operable worm gear and said worm, said operable worm gear comprising:

a body portion; and

a plurality of teeth disposed on said body portion, said plurality of teeth being formed of a resilient material.

Marked up version of claim 37:

CLAIM 37. (amended) The operable worm gear of claim 36 wherein said spring rate is variably dependent upon at least one of a helical angle of [said] a helical thread forming said plurality of teeth and the concavity of each of said teeth of said plurality of teeth.

Marked up version of claim 39:

CLAIM 39. (amended) A worm/worm gear assembly [having low turning torque, low rattle, and low noise], comprising:

a worm having at least one helical tooth; and

a flexible helical cut worm gear, in double flank contact with said worm, and wherein a helix angle of said worm helical tooth is less than a helix angle of said helical cut worm gear.

Marked up version of claim 40:

CLAIM 40. (amended) A method of delashing a gear system, comprising:

disposing a worm in compressive mechanical communication with a worm gear; and

maintaining double flank contact at opposing edges of facing successive worm gear teeth such that during low- or no-load conditions, said double flank contact is maintained between teeth of said worm and said worm gear at outer edges of each of said facing successive worm gear teeth and during higher load conditions said double flank contact extends toward the center of each of said facing successive worm gear teeth.

Marked up version of claim 41:

CLAIM 41. (amended) The method of claim 40 wherein said disposing of said worm in compressive mechanical communication with said worm gear comprises [causing opposing flanks of a tooth of said worm to engage facing flanks of two successive teeth of said worm gear] biasing said worm and said worm gear together.

Marked up version of claim 43:

CLAIM 43. (amended) The method of claim 41 [wherein a helix angle of said worm is skewed relative to] further comprising skewing a helix angle of said worm gear.

Marked up version of claim 44:

CLAIM 44. (amended) The method of claim 41 [wherein an axis of rotation of said worm gear is skewed relative to an axis of rotation of said worm] further comprising skewing an axis of said worm gear relative to an axis of said worm.